Fred Hoyle

The Intelligent Universe

A new view of creation and evolution

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This major work by the eminent theoretical physicist and distinguished author challenges our traditional beliefs about the origins and nature of the Universe and the evolution of life on Earth. In a lucid and engaging style, Fred Hoyle builds an authoritative case against the most sacred cows of the scientific establishment.

The author argues persuasively that we owe our existence to another intelligence which, as part of a deliberate plan, created a structure for life that is far too complex to have risen by random processes.

Among the award-winning scientist's astounding revelations:

- In pre-Copernican days, the Earth was erroneously thought to be the geometrical and physical center of the Universe. Nowadays, in seemingly respectable scientific circles, the Earth is taken to be the biological center of the Universe – an almost incredible repetition of the initial error. Yet nothing is clearer than the fact that all life processes are cosmic in their scope.
- The Darwinian theory of evolution is shown to be plainly wrong. Life has evolved because biological components of cosmic origin have been progressively assembled here on Earth. These components have arrived from outside, borne in from the cosmos on comets.
- Bacteria can survive in the extreme conditions of outer space. In contrast to what we are told by NASA, it looks as if the Viking missions in 1976 proved that life does exist on Mars, and there is now conclusive evidence that life exists throughout the solar system.
- The key to understanding evolution is the virus. The viruses responsible for evolution and the viruses responsible for diseases are very similar. They are different sides of the same coin.
- Despite frequent reports of UFOs, the facts show that space travel beyond our own solar system will always be out of reach. The only space travellers are cosmic microorganisms – the components of the creation and evolution of life.
- There are no differences between the atoms in our bodies and those in inanimate matter – the atomic building blocks of both are the same. It is the arrangement of the atoms that is unique to life.

Beautifully illustrated throughout with photographs, drawings and diagrams to support the flow of argument, *The Intelligent Universe* presents in clear terms to the general reader an all-embracing view of the cosmos that succeeds in fusing the empiricism of the rationalist with the moral instincts of the philosopher. It is a view that fashions a new concept of the Universe, a vision of an infinity fuelled with information and fired by intelligence.

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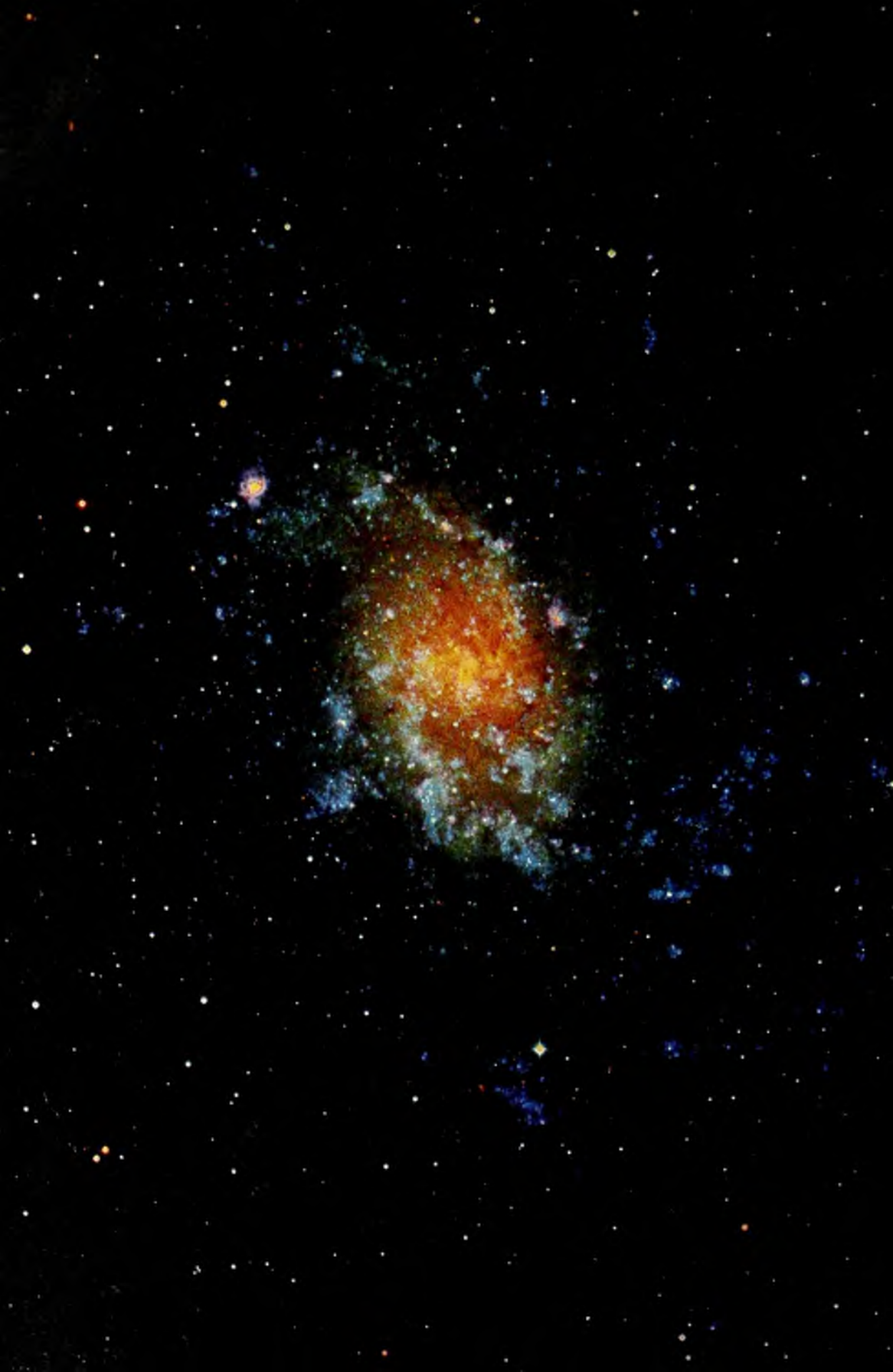
THE INTELLIGENT UNIVERSE



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For Geoffrey

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FOREWORD

Everybody must wonder from time to time if there is any real purpose in life. Of course we all have immediate aims, to succeed in our careers, to bring up our children, and still in many parts of the world simply to earn enough to eat. But what of a long-range purpose? For what reason do we live our lives at all?

Biology, as it is presently taught, answers that the purpose is to produce the next generation. But many of us are impelled to persist in wondering if that can be all. If the purpose of each generation is merely to produce the next, does the overall end result achieved sometime in the distant future have any purpose? No, biology answers once more. There is nothing except continuity, no purpose except continued existence, now or in the future.

If that is so, what is the use of that unique feature of our species, the moral code present in all human societies? Its use lies in promoting our continued existence, the biologist replies. Because humans achieve more by working together in groups, a concern for the welfare of others besides ourselves promotes community survival.

Even if we grant for a moment that this proposition is true, so what? There are many things that would assist our survival which we do not possess. Throughout the history of man it would often have been an advantage in moments of great danger to be able to run like a hare or to soar away from the danger up into the sky like a bird. But we can do neither. These examples show that the logic is back-to-front. Just as desire does not automatically generate that which is desired, so advantage does not automatically generate that which would be an advantage, either in biology or elsewhere.

Man's moral sense is a fragile affair. We have to bolster it with a tangle of laws because in itself virtuous behaviour is not predominantly advantageous to survival. In many cases in our daily lives cheating is more profitable than truthfulness, while brutality and aggression are all too often profitable to the survival of nations. Instead it would be easy to build a

considerable argument to show that the moral sense in man persists despite all the temptations which constantly work against it.

I came across the difficulties with which the moral sense in man has to contend quite early in life. My father was a machine-gunner in the First World War, surviving miraculously in the trenches of northern France and Flanders over three long years. He was one of the few who came through the immense Ludendorff attack of 21 March 1918. His machine-gun post was overrun, not by the usual few hundred yards but by miles, so that he found himself far within the enemy line. My father told me afterwards that this was his worst moment of the war, because of his ever-present expectation of encountering a lone German, with the prospect that, without the possibility of verbal communication between them, the two would be committed to fight it out to the end in armed combat.

It was some years later that I saw the solution to my father's problem. If you were alone in no-man's land, faced by a German with whom you could not talk intelligibly, the best thing to do—unless you had an unhealthy taste for combat to the death—would be to remove your helmet. If the German then had the wit to do the same you would both perceive the fact that, hidden deliberately by the distinctive helmets, you were both members of the same species, almost as similar as two peas in a pod.

Ever since this early perception I have believed that wars are made possible, not by guns and bombs, not by ships and aircraft, but by uniforms, caps and helmets. Should the day ever come when it is agreed among the nations of the world that all armies shall wear the same uniforms and helmets then I will know for sure that at long last war has been banished from the Earth. So far from there being any prospect of this happening, the first thing that every emerging nation does with its army, even ahead of acquiring physical weapons, is to clothe its soldiers in distinctive uniforms, thereby artificially creating a new "subspecies" of man, sworn to destroy other artificially created "subspecies". Such then are the odds against which the moral sense in us all has to contend.

The modern point of view that survival is all has its roots in

Darwin's theory of biological evolution through natural selection. Harsh as it may seem, this is an open charter for any form of opportunistic behaviour. Whenever it can be shown with reasonable plausibility that even cheating and murder would aid the survival either of ourselves personally or the community in which we happen to live, then orthodox logic enjoins us to adopt these practices, just because there is no morality except survival.

If I were called on to defend orthodox science against this unpleasant accusation, I would argue that it is not so much a case of biology influencing the state of society as it is of the state of society controlling the thinking of biologists. I could begin by demonstrating that the ideas of Darwin's theory were already in place by 1830, almost a third of a century before the publication in 1859 of Darwin's book *The Origin of Species*. But while the ideas were there already, the state of society was not yet ripe. An important change was needed before the ideas were called forth.

It is easy to see what this change was. By the 1860s, the industrial scene had burgeoned. Companies were competing fiercely in the production of similar products, railways were competing for traffic, nations were competing for *Lebensraum*. While the latter was not particularly new, the cut-and-thrust of commerce with its threat of ruin on a grand scale certainly was. Improvement of products was the key to survival. From practical experience in commerce it was then a short step to the concept of an improvement of species through natural selection—the Darwinian theory.

Except for a very few scientists, everybody overlooked a crucial step in the analogy between commercial and natural selection. Commercial selection works only because at the back of it there are human intellects constantly striving to improve the range and quality of their products. Commercial selection is therefore very far from the purposeless affair natural selection is taken to be in biology.

In reality, natural selection acts like a sieve. It can distinguish between species presented to it, but it cannot decide what species shall be sieved in the first place. The control over what is presented to the sieve has to enter terrestrial biology from outside itself—not just from outside the living world,

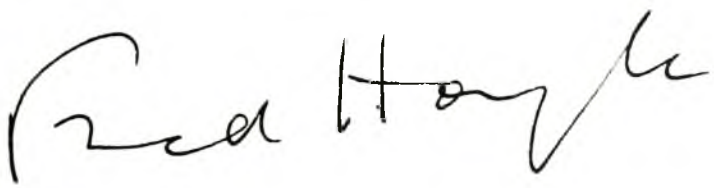
but from far outside the confines of our planet.

There is nowadays a mountain of evidence for this view. We shall explore some of it in the first five chapters of this book. Once one admits that terrestrial biology has been spurred on through evolution by a force outside the Earth itself, then the purposeless outlook of orthodox opinion becomes threatened. For just as the human intellect driving commerce is purposeful, so too may be the driving influence in biology.

This indeed is just what orthodox scientists are unwilling to admit. Because there might turn out to be—for want of a better word—religious connotations, and because orthodox scientists are more concerned with preventing a return to the religious excesses of the past than in looking forward to the truth, the nihilistic outlook described above has dominated scientific thought throughout the past century.

This book is as vigorous a protest against this outlook as I have ever launched. Frankly, I am haunted by a conviction that the nihilistic philosophy which so-called educated opinion chose to adopt following the publication of *The Origin of Species* committed mankind to a course of automatic self-destruction. A Doomsday machine was then set ticking. Whether this situation is still retrievable, whether the machine can be stopped in some way, is unclear—a question I shall return to at the end of this book.

The number of people who nowadays sense that something is fundamentally amiss with society is not small, but sadly they dissipate their energies in protesting against one inconsequential matter after another. The correct thing to protest, as I propose to do here with something approaching mathematical precision, is the cosmic origin and nature of man.



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CHANCE AND THE UNIVERSE

Could life have evolved at random? • The problem of giant molecules • The cell's chemical weapons • Biology's junkyard mentality • Seeing through the primordial soup • The blind alley of Darwinism

A generation or more ago a profound disservice was done to popular thought by the notion that a horde of monkeys thumping away on typewriters could eventually arrive at the plays of Shakespeare. This idea is wrong, so wrong that one has to wonder how it came to be broadcast so widely. The answer I think is that scientists wanted to believe that anything at all, even the origin of life, could happen by chance, if only chance operated on a big enough scale. This is the obvious error, for the whole Universe observed by astronomers would not be remotely large enough to hold the horde of monkeys needed to write even one scene from one Shakespeare play, or to hold their typewriters, and certainly not the wastepaper baskets needed for throwing out the volumes of rubbish which the monkeys would type. The striking point is that the only practicable way for the Universe to produce the plays of Shakespeare was through the existence of life producing Shakespeare himself.

Despite this, the entire structure of orthodox biology still holds that life arose at random. Yet as biochemists discover more and more about the awesome complexity of life, it is

Some events, like solving the Rubik cube at random, have an unlikelihood that approaches the impossible. But the accidental origin of life is more unlikely still.

apparent that the chances of it originating by accident are so minute that they can be completely ruled out. Life cannot have arisen by chance.

Life's improbable building blocks

The probability of life appearing spontaneously on Earth is so small that it is very difficult to grasp without comparing it with something more familiar. Imagine a blindfolded person trying to solve the recently fashionable Rubik cube. Since he can't see the results of his moves, they must all be at random. He has no way of knowing whether he is getting nearer the solution or whether he is scrambling the cube still further. One would be inclined to say that moving the faces at random would "never" achieve a solution. Strictly speaking, "never" is wrong, however. If our blindfolded subject were to make one random move every second, it would take him on average three hundred times the age of the Earth, 1,350 billion years, to solve the cube. The chance against each move producing perfect colour matching for all the cube's faces is about 50,000,000,000,000,000,000 to 1.

These odds are roughly the same as you could give to the idea of just one of our body's proteins having evolved randomly, by chance. However, we use about 200,000 types of protein in our cells. If the odds against the random creation of one protein are the same as those against a random solution of the Rubik cube, then the odds against the random creation of all 200,000 are almost unimaginably vast.

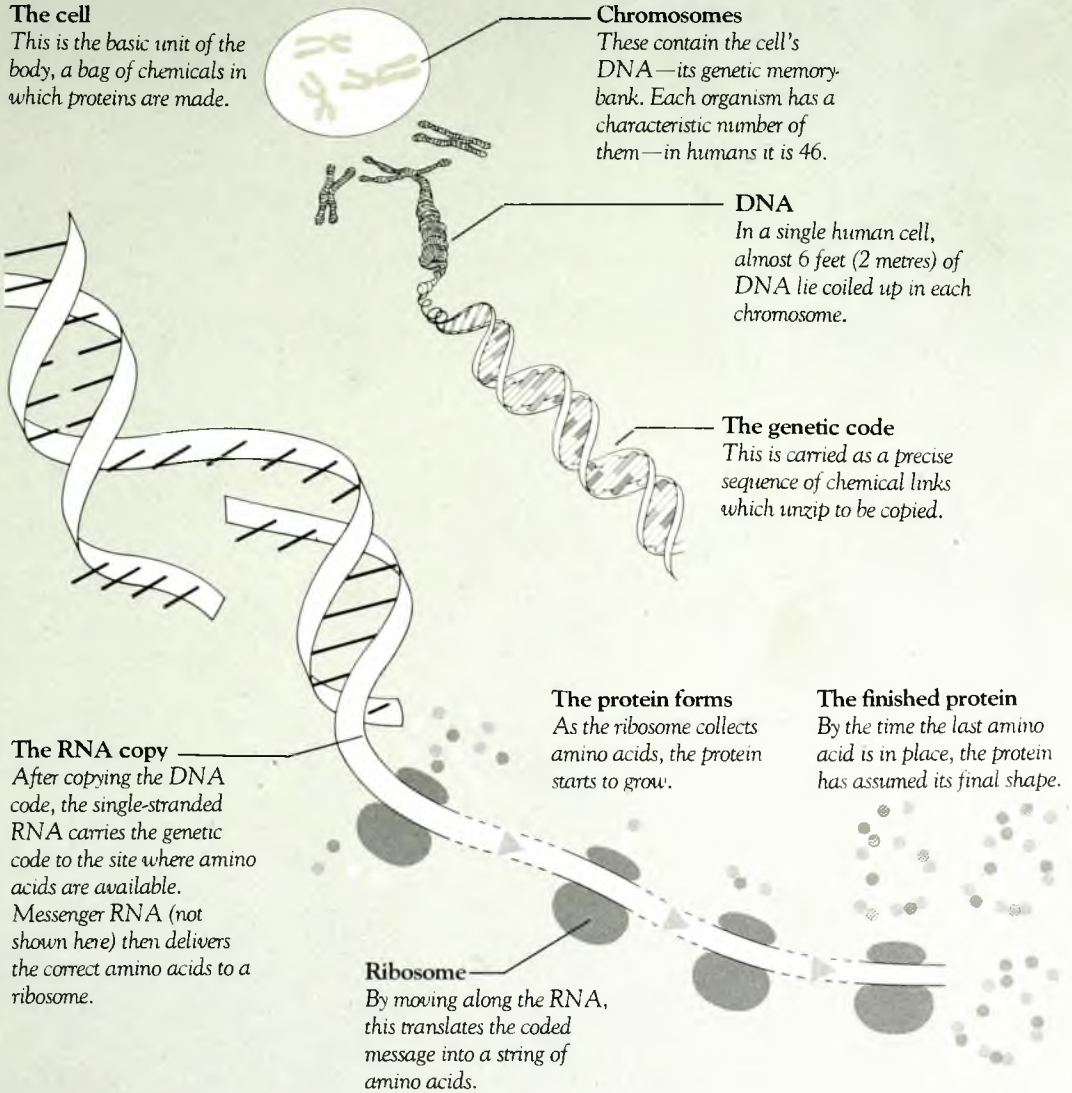
Proteins are among the most complicated chemical components of the body. Each performs specific tasks—for example forming the materials which give the body its structure, carrying substances from one place to another, or acting as keys which turn biochemical reactions on and off. Yet all these 200,000 widely different proteins are made up of the same basic ingredients, rather simple substances known as amino acids, arranged in chains in precise sequences.

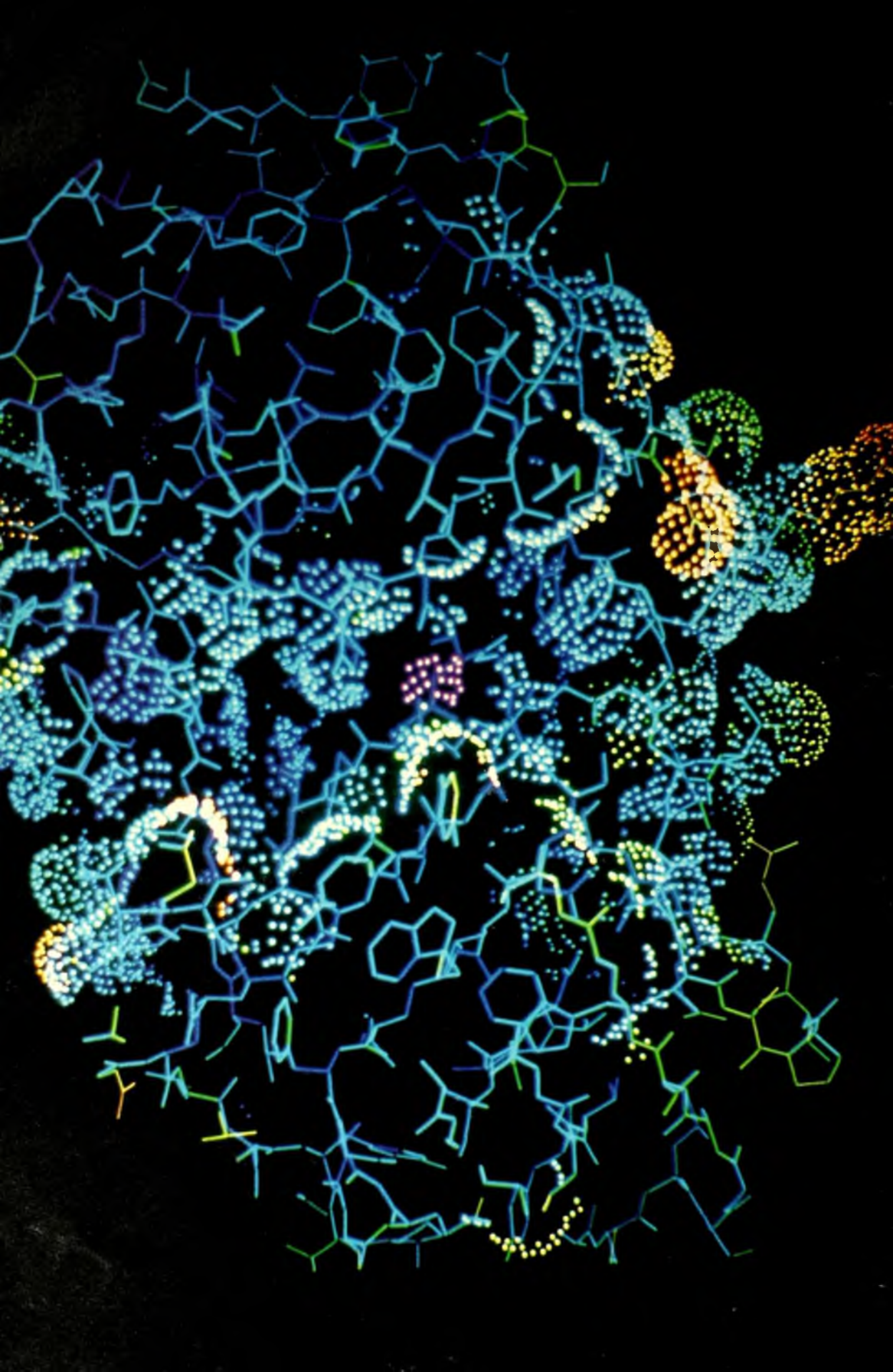
We need not dwell on the detailed structure of amino acids. It is sufficient to think of each one as a bead, with a different colour for each kind. A protein is then like a string of coloured beads, with the exact interspersing of the colours

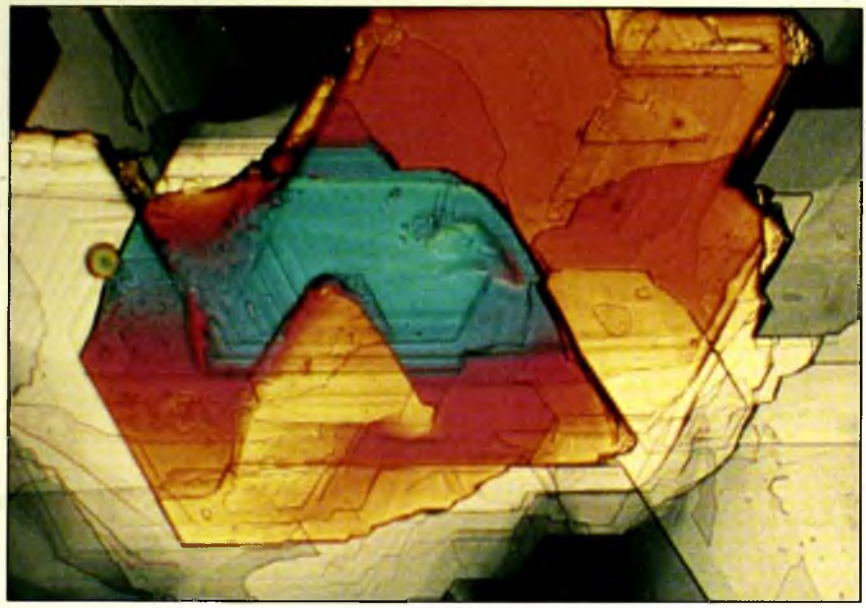
HOW PROTEINS ARE MADE

Making proteins is a complex business which is carried out on a massive scale. Throughout the life of a cell, coded instructions from DNA stored in chromosomes are copied and used to direct protein manufacture. These copies, strands of the shorter RNA, are "read" by ribosomes, complex molecules that move along the RNA, stringing together amino acids in the order dictated by the code. As the amino acids are added one by one, the growing chain twists and turns into a complex shape, characteristic of the protein being made.

Protein manufacture is amazingly accurate. One red blood cell for example contains many thousands of molecules of the protein haemoglobin, and millions of red blood cells are made every second in the human body. Yet, unless the DNA code itself contains an error, every molecule of haemoglobin that it produces turns out exactly right.







Life's building blocks
Crystals of the amino acid leucine, seen here in polarized light, are made up of molecules each containing just 22 atoms. By contrast, the number of atoms in the average protein runs into many thousands.

determining its shape and function. A typical protein is made up of a chain about one hundred beads long, containing at the most twenty different colours.

The operation of a successful life-form is like a successful military operation—both have two sharply distinct requirements. Adequate hardware in the form of weapons is essential, and adequate software in the form of strategy is also needed. Many of the 200,000 proteins used in our cells—the protein "keys"—are the software of the cell. The essence of a key is that one pattern will provide a key that is just as effective as any other. So to calculate fairly the probability of life arising by chance we shall ignore all the proteins which might be keys, and instead concentrate on the minority which have shapes that are vitally important. For these special proteins, the enzymes, the correct string of amino acid "beads" is essential, because alterations can make them useless.

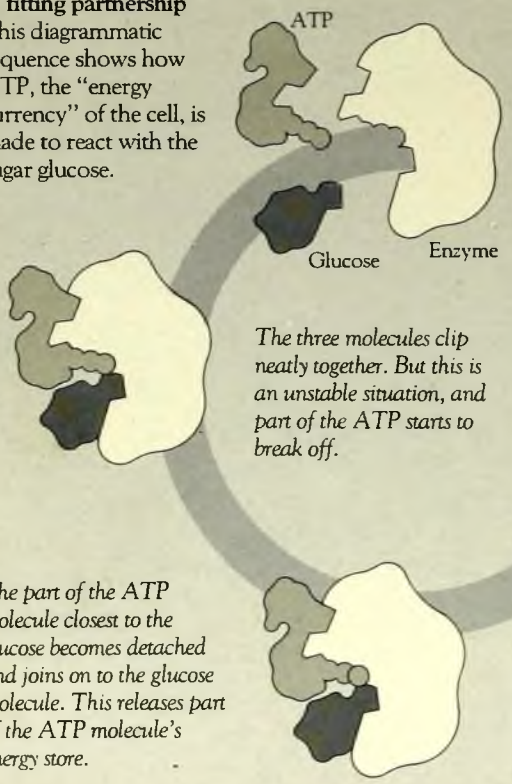
The molecular matchmakers

Enzymes are the equivalent of military hardware. They are protein weapons used by a cell in its battle for survival against the physical environment. Their function is to act as intermediaries between other biochemicals and to catalyze or

Anatomy of a protein
This computer-generated display of a protein (opposite) *shows the complex tangle of its chain of amino acids. Part of the protein's convoluted surface can be seen as points of light clustered around the amino acid backbone.*

AN ENZYME AT WORK

A fitting partnership This diagrammatic sequence shows how ATP, the "energy currency" of the cell, is made to react with the sugar glucose.



In the human body, millions of biochemical reactions happen every millisecond, and almost every one is controlled by an enzyme. Without enzymes, many of these reactions would take minutes or even longer—too slow for life to be maintained.

Enzymes work through their structure. The substances that are to react together slot into recesses in the enzyme like a hand into a glove. Once in position, their chemical structure is put under stress by the presence of the enzyme. The result is that they react, the crucial rearrangement takes place, and the two products disengage from the enzyme. The enzyme itself is immediately ready for a repeat performance.

The three molecules clip neatly together. But this is an unstable situation, and part of the ATP starts to break off.

The part of the ATP molecule closest to the glucose becomes detached and joins on to the glucose molecule. This releases part of the ATP molecule's energy store.

As soon as the transfer is complete, the enzyme's hold on the reacting molecules weakens, and they fall out of their respective slots. The reaction depends on the enzyme's structure being exactly right. Just one critical mistake in its amino acid chain is enough to prevent it working.

speed up processes which provide both nutrients and energy for life. Left to themselves most chemical reactions of importance in biology would proceed so slowly that life would be impossible. The food we eat would be useless to us because its chemical components and energy could not be released fast enough to keep us alive. Enzymes speed these processes up enormously.

In total there are perhaps 2,000 such enzymes, and their structures are basically the same across the whole of the living world—an enzyme from a bacterium can be used in the cell of a man. The chance of finding each individual enzyme by stringing together amino acid beads at random is again like the Rubik cube being solved by a blindfolded person. Although the chance of finding all the enzymes, 2,000 of them, by

random processes is not nearly as small as the chance of finding the whole 200,000 proteins on which life depends, the chance is still exceedingly minute. Call it x to 1 against. If you started to write x out in longhand form, beginning with the digit 1 and adding zeros, you would have a few hours of work ahead—1, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000... and so on for about forty pages, some 40,000 zeros in all. It is about the same as the chance of throwing an uninterrupted sequence of 50,000 sixes with unbiased dice! This is a crucial statistic, because it seems that without these 2,000 enzymes being formed in exactly the correct way, complex living organisms simply could not operate.

Although the probability of the random origin of "just" these 2,000 enzymes is minuscule, there are many scientists who do not see this calculation as dismissing the idea that life arose by chance. Like all statistics, probabilities of this type are open to different interpretations. One important point which has to be established is the context in which we are talking.

Were there many ways in which life could have evolved? The argument I have used above would be weakened if the origin of life as it is found on Earth happened to be just one highly improbable event taken out of a vast number of potentially similar events. Imagine a golfer playing a tee-shot for example. Suppose he makes a long drive and his ball lands far down the fairway and comes to rest on a particular tuft of grass. The chance of the ball arriving on this particular spot was tiny. However, there is a huge number of similar places that the ball could have landed on, and the chance of the ball arriving somewhere on the fairway (assuming a reasonably proficient player) was almost a certainty.

Could it be that this was what the origin of life was like? The odds of finding life with our basic form of chemistry might be exceedingly small, but could there not be—like all the points on the fairway—a vast number of other kinds of biology, which we know nothing about, each with its own very small chance of becoming established on a planet like the Earth?

I think not. The reason why this question must be answered negatively, and why we must therefore abandon this way of avoiding the startling conclusion that life cannot have

arisen by chance, is that the chemical reactions catalyzed by the 2,000 enzymes are fundamental to the basic chemistry of the carbon atom itself. Despite its complexity, our biochemistry may well be the simplest form possible. Take, for example, sugars, the main energy source of life. These are built up from the two commonest molecules in the Universe, the molecules of hydrogen and carbon monoxide. Thus the enzymes we use to unlock the energy content of sugars are engaged in processes which are central to the chemical content of the whole Universe. Hence there is nothing hole-in-the-corner about our terrestrial system. There are not vast billions of other equally likely systems. Indeed it is to be doubted whether there is even *one* other system that operates so fundamentally on molecules composed of the commonest atoms in the Universe, the atoms of carbon, oxygen, nitrogen and hydrogen.

The idea of the primordial soup

The popular idea that life could have arisen spontaneously on Earth dates back to experiments that caught the public imagination earlier this century. If you stir up simple non-organic molecules like water, ammonia, methane, carbon dioxide and hydrogen cyanide with almost any form of intense energy, ultraviolet light for instance, some of the molecules reassemble themselves into amino acids, a result demonstrated about thirty years ago by Stanley Miller and Harold Urey. The amino acids, the individual building blocks of proteins can therefore be produced by natural means. But this is far from proving that life could have evolved in this way. No one has shown that the correct arrangements of amino acids, like the orderings in enzymes, can be produced by this method. No evidence for this huge jump in complexity has ever been found, nor in my opinion will it be. Nevertheless, many scientists have made this leap—from the formation of individual amino acids to the random formation of whole chains of amino acids like enzymes—in spite of the obviously huge odds against such an event having ever taken place on the Earth, and this quite unjustified conclusion has stuck.

In a popular lecture I once unflatteringly described the